

1307.65742

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Ishii et al.)
)
Divisional of)
Serial No.: 08/690,038)
)
Filed: July 31, 1996)
)
For: PLASMA DISPLAY PANEL,)
METHOD OF DRIVING SAME)
AND PLASMA DISPLAY)
APPARATUS)
)
Art Unit: 2675)
)
Examiner: Awad, A.)

I hereby certify that this paper is being deposited with the United States Postal Service as Express Mail in an envelope addressed to: Box Patent Application, Asst. Comm. for Patents, Washington, D.C. 20231, on this date.

Sept. 28, 2001
Date


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PRELIMINARY AMENDMENT A

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to consideration and calculating the fees for the above-referenced Application, please amend the Application as follows:

IN THE SPECIFICATION:

In the specification, on page 1, line 1, please insert the following sentence before the paragraph beginning on page 1, line 5.

08/690,038

--This Application is a divisional of Serial No. 08/690,038, filed on July 31, 1996.--

Please replace the paragraph beginning on page 1, line 9, with the following rewritten paragraph:

-- The plasma display panel (PDP) has good visibility because it generates its own light, is thin and can be made with large-screen and high-speed display. For these reasons it is attracting interest as a replacement for the CRT display. A surface discharge AC PDP is especially suitable for full color display. Therefore, there are high expectations in the field of high-vision and the demand for a higher quality image is increasing. A higher quality image is achieved by generating higher definition, a higher number of gradations, better brightness, lower brightness for black areas, higher contrast and the like. High definition is achieved by narrowing the pixel pitch, a higher number of gradations is achieved by increasing the number of subfields within a frame, higher brightness is achieved by increasing the number of times a sustaining discharge is performed, and lower brightness for deeper blacks is achieved by reducing the quantity of light emission during the reset period.--

Please replace the paragraph beginning on page 2, line 6, with the following rewritten paragraph:

-- On the observer-side of one of the glass substrates that face each other, electrodes X1 to X5 are formed in parallel to one another at an equal pitch, and electrodes Y1 to Y5 are formed in parallel to one another to form parallel pairs with the corresponding electrodes X1 to X5. On the other glass substrate, address electrodes A1 to A6 are formed in the direction that runs at a right angle to the aforementioned electrodes, and phosphor covers on that. Between the glass substrates that face each other, partitioning walls 171 to 177 and partitioning walls 191 to 196 are arranged intersecting each other in a lattice, to ensure that no erroneous display is made through discharge of one pixel affecting adjacent pixels.

Please replace the paragraph beginning on page 2, line 19, with the following rewritten paragraph:

--The surface discharge PDPs have an advantage in that the phosphor does not become degraded due to the impact of ions on it since discharge occurs between adjacent electrodes on the same surface. However, since a pair of electrodes is provided for each of the display lines L1 to L5, the degree to which the pixel pitch can be reduced is limited and this is a stumbling block for achieving high definition. In addition, the scale of the drive circuit must be large since there is a high number of electrodes.--

Please replace the paragraph beginning on page 4, line 21, with the following rewritten paragraph:

--Moreover, since the color of the phosphor is white or bright gray, incident light from the outside is reflected on the phosphor at non display lines when observing an image on the PDP in a bright place, lowering the contrast of the image.--

Please replace the paragraph beginning on page 5, line 1, with the following rewritten paragraph:

--In addition, since only one line can be addressed at a time, the address time cannot be reduced, and it is not possible to achieve a higher number of gradations by increasing the number of subfields or to achieve higher brightness by increasing the number of times the sustaining discharge is performed.--

Please replace the paragraph beginning on page 5, line 8, with the following rewritten paragraph:

--Accordingly, a comprehensive object of the present invention is to provide a plasma display panel, a method of driving same and a plasma display apparatus, all of which achieve a higher quality image.--

Please replace the paragraph beginning on page 5, line 12, with the following rewritten paragraph:

--To put it concretely, a first object of the present invention is to provide a method of driving a plasma display panel and a plasma display apparatus, which achieve higher definition by further reducing the pixel pitch.--

Please replace the paragraph beginning on page 6, line 3, with the following rewritten paragraph:

--A fourth object of the present invention is to provide a plasma display panel, a method of driving the same and a plasma display apparatus that can increase the number of gradations and brightness by addressing plural display lines simultaneously to decrease the address period.--

Please replace the paragraph beginning on page 6, line 8, with the following rewritten paragraph:

--According to the first aspect of the present invention, there is provided a plasma display apparatus comprising: a plasma display panel having a substrate, electrodes X1 to X_{n+1} formed at the substrate, electrodes Y1 to Y_n formed at the substrate and address electrodes formed at the substrate or at another substrate facing the substrate at a distance, the electrodes X1 to X_{n+1} being arranged in that order and parallel to one another, an electrode Y_i being arranged between an electrode X_i and an electrode X_{i+1} for each $i = 1$ to n , the address electrodes being arranged intersecting the electrodes X1 to X_{n+1} and Y1 to Y_n at a

distance; and an electrode drive circuit; wherein the electrode drive circuit includes: first field addressing means, for $i = 1$ to n , for causing a first address discharge to occur between the electrode Y_i and the address electrodes selected in correspondence to display data in a first field of a frame and for causing a discharge to occur between the electrode Y_i and the electrode X_i using the first address discharge as a trigger to generate a first wall charge required for a sustaining discharge in correspondence to the display data in the first field; first field sustaining means, after the first wall charge has been generated and for odd number o among 1 to n and for even number e among 1 to n , for supplying a first AC sustaining pulse between an electrode Y_o and an electrode X_o and for supplying a second AC sustaining pulse between an electrode Y_e and an electrode X_e ; second field addressing means, for $i = 1$ to n , for causing a second address discharge to occur between the electrode Y_i and the address electrodes selected in correspondence to display data in a second field of the frame and for causing a discharge to occur between the electrode Y_i and the electrode X_{i+1} using the second address discharge as a trigger to generate a second wall charge required for a sustaining discharge in correspondence to the display data in the second field; and second field sustaining means, after the second wall charge has been generated and for odd number o among 1 to n and for even number e among 1 to n , for supplying a third AC sustaining pulse between the electrode Y_o and the electrode X_{o+1} and for supplying a fourth AC sustaining pulse between the electrode Y_e and the electrode X_{e+1} .--

Please replace the paragraph beginning on page 7, line 24, with the following rewritten paragraph:

--With the first aspect of the present invention, since the display lines in odd-numbered fields and the display lines in even-numbered fields can be made so as not to affect each another in regard to discharge, it is not necessary to provide partitioning walls along the central lines on the electrodes X1 to Xn+1 and electrodes Y1 to Yn of the plasma display panel. Thus, production of the plasma display panel is facilitated, reducing the production cost and, with the pixel pitch reduced, higher definition can be achieved.--

Please replace the paragraph beginning on page 8, line 9, with the following rewritten paragraph:

-- In the first mode of the first aspect of the present invention, the first field sustaining means supplies the first and second AC sustaining pulses while ensuring that voltage waveforms applied to the electrodes Yo and Xe are of the same phase to each other, that voltage waveforms applied to the electrodes Ye and Xo are of the same phase to each other and that the first and second AC sustaining pulses are of the reverse phase to each other; and the second field sustaining means supplies the third and fourth AC sustaining pulses while ensuring that voltage waveforms applied to the electrodes Yo and Xo are of the same phase to each other, that voltage waveforms applied to the electrodes Ye and Xe are of

the same phase to each other and that the third and fourth AC sustaining pulses are of the reverse phase to each other.--

Please replace the paragraph beginning on page 8, line 24, with the following rewritten paragraph:

-- The first mode is effective since the display lines in odd-numbered fields and the display lines in even-numbered fields do not affect each other in regard to discharge.--

Please replace the paragraph beginning on page 9, line 2, with the following rewritten paragraph:

-- In the second mode of the first aspect of the present invention, the first field addressing means, in a first period, applies a DC voltage to all odd-numbered electrodes among the electrodes X1 to Xn+1 and applies a pulse with a reverse polarity voltage against the DC voltage to the electrode Yo, and in a second period, applies the DC voltage to all even-numbered electrodes among the electrodes X1 to Xn+1 and applies a pulse with a reverse polarity voltage against the DC voltage to the electrode Ye; and the second field addressing means, in a third period, applies the DC voltage to all the even-numbered electrodes among the electrodes X1 to Xn+1 and applies a pulse with a reverse polarity voltage against the DC voltage to the electrode Yo, and in a fourth period, applies the DC

voltage to all the odd-numbered electrodes among the electrodes X1 to Xn+1 and applies a pulse with a reverse polarity voltage against the DC voltage to the electrode Ye.--

Please replace the paragraph beginning on page 9 line 19, with the following rewritten paragraph:

--With the second mode, only one pulse with a large width needs to be supplied to each of the odd-numbered group and the even-numbered group of the electrodes X1 to Xn+1 during each address period for the odd-numbered fields and the even-numbered fields.

Thus, power consumption is reduced compared to a case in which the pulse must be supplied to those groups for every scan of the electrodes Y1 to Yn. In addition, the structure of the electrode drive circuit can be simplified.--

Please replace the paragraph beginning on page 10, line 3, with the following rewritten paragraph:

--In the third mode of the first aspect of the present invention, the first field addressing means applies pulses with reverse polarity voltages to each other to the electrodes Yi and Xi when causing the discharge to occur between the electrode Yi and the electrode Xi; and the second field addressing means applies pulses with reverse polarity voltages to each other to the electrodes Yi and Xi+1 when causing the discharge to occur between the electrode Yi and the electrode Xi+1.--

Please replace the paragraph beginning on page 10, line 12, with the following rewritten paragraph:

-- With the third mode, since only the required pulse is supplied to the electrodes X1 to Xn+1 during an address period, power consumption is reduced compared to a case in which pulses are commonly supplied to the odd-numbered group and the even-numbered group among the electrodes X1 to Xn+1.--

Please replace the paragraph beginning on page 10, line 18, with the following rewritten paragraph:

--In the fourth mode of the first aspect of the present invention, the first and second field addressing means includes: a first sustain circuit for outputting a first voltage-waveform of a DC pulse train; a second sustain circuit for outputting a second voltage-waveform with its phase offset by 180° from a phase of the first voltage-waveform; a switching circuit having switching elements for selectivity supplying either the first or second voltage-waveform to the electrodes Yo, Ye, Xo and Xe; and a control circuit for controlling the switching elements of the switching circuit in such a way that the first voltage-waveform is supplied to the electrodes Yo and Xe and the second voltage-waveform is supplied to the electrodes Ye and Xo after the first wall charge has been generated and that the first voltage-waveform is supplied to the electrodes Ye and Xe after the second wall charge has been generated.--

Please replace the paragraph beginning on page 11, line 11, with the following rewritten paragraph:

--With the fourth mode, since the voltage-waveforms from the first sustain circuit and the second sustain circuit are selectively supplied to the electrodes Yo, Ye, Xo and Xe, the structure of the electrode drive circuit is simplified.--

Please replace the paragraph beginning on page 11, line 15, with the following rewritten paragraph:

--In the fifth mode of the first aspect of the present invention, both the first field and the second field consist of a plurality of subfields with numbers of sustaining discharge pulses different from one another, and the electrode drive circuit further comprising: first field reset means, prior to the first address discharge in a first subfield of the first field and for $i=1$ to n , for causing a discharge to occur between the electrode Yi and the electrode Xi and between the electrode Yi and the electrode Xi+1 in order to eliminate wall charge for all pixels or to generate wall charge for all pixels; and prior to the first address discharge in the rest of the subfields of the first field and for odd number o among 1 to n and for even number e among 1 to n, for causing a discharge D1 to occur between the electrode Yo and the electrode Xo and a discharge D2 to occur between the electrode Ye and the electrode Xe with a time lag from the discharge D1 in order to eliminate or generate wall charge only for pixels in the first field; and second field reset means, prior to the second

address discharge in a first subfield of the second field and for $i=1$ to n , for causing a discharge to occur between the electrode Y_i and the electrode X_i and between the electrode Y_i and the electrode X_{i+1} in order to eliminate wall charge for all pixels or to generate wall charge for all pixels; and prior to the second address discharge in the rest of the subfields of the second field and for odd number o among 1 to n and for even number e among 1 to n , for causing a discharge $D3$ to occur between the electrode Y_o and the electrode X_{o+1} and a discharge $D4$ to occur between the electrode Y_e and the electrode X_{e+1} with a time lag from the discharge $D3$ in order to eliminate or generate wall charge only for pixels in the second field.--

Please replace the paragraph beginning on page 12, line 22, with the following rewritten paragraph:

--With the fifth mode, since unwanted light emission is reduced, the brightness of black display is lowered to improve the black display quality.--

Please replace the paragraph beginning on page 12, line 25, with the following rewritten paragraph:

-- In the sixth mode of the first aspect of the present invention, each of the electrodes X_1 to X_{n+1} and Y_1 to Y_n includes: a transparent electrode formed at the substrate; and a metal electrode formed at the transparent electrode along the central line of the transparent electrode with a width smaller than the transparent electrode.--

Please replace the paragraph beginning on page 13, line 6, with the following rewritten paragraph:

--With the sixth mode, the structure of each display line is made identical.--

Please replace the paragraph beginning on page 13, line 8, with the following rewritten paragraph:

--According to the second aspect of the present invention, there is provided a plasma display apparatus comprising: a plasma display panel having a substrate, electrodes X1 to X2n formed at the substrate, electrodes Y1 to Yn formed at the substrate and address electrodes formed at the substrate or at another substrate facing the substrate at a distance, electrodes X_o, Y_i and X_e being arranged in that order parallel to one another, where $o = 2i - 1$, $e = 2i$ and $i = 1$ to n , the address electrodes being arranged intersecting the electrodes X1 to X2n and Y1 to Yn at a distance; and an electrode drive circuit; wherein the electrode drive circuit includes: odd-numbered frame addressing means, for $o = 2i - 1$ and $i = 1$ to n , for causing a first address discharge to occur between the electrode Y_i and the address electrodes selected in correspondence to display data in an odd-numbered frame and for causing a discharge to occur between the electrode Y_i and the electrode X_o using the first address discharge as a trigger to generate a first wall charge required for a sustaining discharge in correspondence to the display data in the odd-numbered frame; odd-numbered frame sustaining means, for $o = 2i - 1$ and $i = 1$ to n , for supplying a first AC sustaining pulse

between the electrode Y_i and the electrode Y_o after the first wall charge has been generated; even-numbered frame addressing means, for $e=2i$ and $i = 1$ to n , for causing a second address discharge to occur between the electrode Y_i and the address electrodes selected in correspondence to display data in an even-numbered frame and for causing a discharge to occur between the electrode Y_i and the electrode X_e using the second address discharge as a trigger to generate a second wall charge required for a sustaining discharge in correspondence to the display data in the even-numbered frame; and even-numbered frame sustaining means, for $e=2i$ and $i = 1$ to n , for supplying a second AC sustaining pulse between the electrode Y_i and the electrode Y_e after the second wall charge has been generated.--

Please replace the paragraph beginning on page 15, line 11, with the following rewritten paragraph:

-- Moreover, with frame interlaced scanning, the address period can be reduced by half compared to that with non-interlaced scanning, lengthening the period of sustaining discharge. This makes it possible to achieve a higher number of gradations by increasing the number of sub frames or makes it possible to achieve higher brightness by increasing the number of times the sustaining discharge is performed.--

Please replace the paragraph beginning on page 15, line 19, with the following rewritten paragraph:

--In the first mode of the second aspect of the present invention, the electrodes Xo, Yi and Xe have substantially symmetrical forms relative to a central line of the electrode Yi; each of the electrodes has a transparent electrode formed at the substrate, and a metal electrode formed at the transparent electrode at a width smaller than that of the transparent electrode; and the metal electrodes of the electrodes Xo and Xe are arranged on sides away from the electrode Yi.--

Please replace the paragraph beginning on page 16, line 3, with the following rewritten paragraph:

--With the first mode, since, when a voltage is supplied between the electrodes Xo and Yi for instance, the electric field above the electrode Xo becomes more intense on the metal electrode side, the pixel area can be increased essentially compared to a case in which the metal electrode is formed along the central line on the transparent electrode, even if the electrode pitch is reduced to achieve higher definition. This does not present any problem, since the sides of the electrodes Xo and Xe, which are opposite to the electrode Yi, are non display lines, and as the non display lines can be narrowed essentially, this is desirable.--

Please replace the paragraph beginning on page 16, line 15, with the following rewritten paragraph:

-- In the second mode of the second aspect of the present invention, the electrodes Xo, Yi and Xe have substantially symmetrical forms relative to a central line of the electrode Yi; the electrode Yi is a metal electrode formed at the substrate; each electrode Xo and electrode Xe has a transparent electrode formed at the substrate, and a metal electrode formed at the transparent electrode at a width smaller than that of the transparent electrode; and the metal electrodes of the electrodes Xo and Xe are arranged on sides away from the electrode Yi.--

Please replace the paragraph beginning on page 16, line 25, with the following rewritten paragraph:

--With the second mode, since the width of the electrode Yi becomes small, the power consumption of supplying scanning pulses to the electrode Yi is reduced. In addition, it is possible to further reduce the pixel pitch. --

Please replace the paragraph beginning on page 17, line 4, with the following rewritten paragraph:

--In the third aspect of the present invention, there is provided a plasma display panel comprising substrate sustaining electrodes, for sustaining discharge, formed in parallel to one another at the substrate and address electrodes formed at the substrate or at another

substrate facing the substrate at a distance, the address electrodes being arranged intersecting the sustaining electrodes at a distance in parallel to one another, the plasma display panel further comprising a light blocking member at a non display line between adjacent electrodes of the sustaining electrodes.--

Please replace the paragraph beginning on page 17, line 15, with the following rewritten paragraph:

--With the third aspect, by employing the light blocking member, reduction of the black display quality caused by discharge light emission at the non display line can be decreased.--

Please replace the paragraph beginning on page 17, line 19, with the following rewritten paragraph:

--In the first mode of the second aspect of the present invention, the address electrodes are covered with phosphor, and an observer-side surface of the light blocking member has darker color than the phosphor.--

Please replace the paragraph beginning on page 17, line 23, with the following rewritten paragraph:

--With the first mode, since incident light from the outside to the phosphor at the non display line is absorbed by the light blocking member, the contrast of an image on the

PDP in a bright place increases more than a case that incident light from the outside to the phosphor at the non display line is reflected and enters eyes of an observer.--

Please replace the paragraph beginning on page 18, line 4, with the following rewritten paragraph:

--In the fourth aspect of the present invention, there is provided a plasma display apparatus comprising: a plasma display panel having a substrate, electrodes X1 to Xn formed at the substrate, electrodes Y1 to Yn formed at the substrate, address electrodes formed at the substrate or at another substrate facing the substrate at a distance and a light blocking member between electrodes Yi and Xi+1, where i=1 to n-1, electrodes Xi and Yi being arranged by turns in parallel, where i=1 to n; and an electrode drive circuit; wherein the electrode drive circuit includes: reset means, for i=1 to n-1, for causing a discharge to occur between the electrode Yi and an electrode Xi+1 while ensuring that voltage waveforms applied to the electrodes Xi and Yi are in the same phase to each other and that voltage waveforms applied to the electrode Xn and the electrode Yn are in the same phase to each other in a reset period; addressing means, for i=1 to n, for causing an address discharge to occur between either the electrode Xi or Yi and the address electrode selected in correspondence to display data and causes a discharge to occur between the electrode Xi and electrode Yi using the address discharge as a trigger to generate a wall charge required for a sustaining discharge in correspondence to the display data in an address period after the reset period has elapsed; and sustaining means, for i=1 to n, for supplying an AC sustaining pulse

between the electrode Xi and the electrode Yi in a sustain period after the address period has elapsed.--

Please replace the paragraph beginning on page 19, line 6, with the following rewritten paragraph:

--With the fourth aspect, by employing the light blocking member, reduction of the black display quality caused by light emission during a reset period can be decreased. Although the light blocking member will somewhat prevent achieving higher definition, in comparison to the structure in the prior art shown in FIG. 30, since it is not necessary to form the partitioning walls 191 to 196, production is facilitated and the pixel pitch can be further reduced.--

Please replace the paragraph beginning on page 19, line 14, with the following rewritten paragraph:

-- In the fifth aspect of the present invention, there is provided a plasma display panel comprising a substrate, address electrode bundles formed along to one another at the substrate and scanning electrodes, for causing a discharge between the address electrode bundles and the scanning electrodes to generate a wall charge required for a sustaining discharge in correspondence to display data, the scanning electrodes intersecting the address electrode bundles at a distance, wherein each of the address electrode bundles includes: m ($m \geq 2$) number of address electrodes formed along to one another at the substrate in

correspondence to one monochromatic pixel column; pads arranged along a lengthwise direction of the address electrodes corresponding to each monochromatic pixel, the pads being above the m number of address electrodes relative to the substrate; and contacts for connecting one pad to one of the address electrodes in a regular manner along the lengthwise direction of the address electrodes.--

Please replace the paragraph beginning on page 20, line 8, with the following rewritten paragraph:

--In the fifth aspect, by selecting m number of the scanning electrodes intersecting the pads connected to the m number of address electrodes simultaneously; and by applying voltages corresponding to display data to the m number of address electrodes simultaneously; scanning of the scanning electrodes is executed in units of m lines.--

Please replace the paragraph beginning on page 20, line 14, with the following rewritten paragraph:

-- With the fifth aspect, a plurality of lines can be addressed at the same time, reducing the address period and, because of this, a higher number of gradations becomes possible by increasing the number of subfields or it becomes possible to achieve higher brightness by increasing the number of times sustaining discharge is performed.--

IN THE CLAIMS:

Please cancel claims 1-20 without prejudice, and enter the following new claims 21-25 as follows:

21. (New Claim) A method of driving a plasma display panel having a plurality of pairs of display electrodes with each pair including an X-electrode and a Y-electrode, said method comprising the steps of:

applying at least one first discharge sustaining pulse to a first pair of said display electrodes; and

applying at least one second discharge sustaining pulse to a second pair of said display electrodes, said second pair of display electrodes being adjacent to said first pair of display electrodes,

wherein said at least one first discharge sustaining pulse and said at least one second discharge sustaining pulse are applied such that a current in said first pair of display electrodes flows in the opposite direction from a current in said second pair of display electrodes.

22. (New Claim) The method according to claim 21, further comprising:

applying a set of said first discharge sustaining pulses to each electrode in said first pair of display electrodes, both of said sets of first discharge sustaining pulses being different in phase from each other; and

simultaneously applying a set of said second discharge sustaining pulses to each electrode in said second pair of display electrodes, both of said sets of second discharge sustaining pulses being different in phase from each other;

wherein said set of first discharge sustaining pulses applied to one electrode in said first pair of display electrodes and said set of second discharge sustaining pulses applied to an adjacent electrode in said second pair of display electrodes are in the same phase as each other.

23. (New Claim) A method of driving a plasma display panel having a plurality of pairs of display electrodes, said method comprising the steps of:

applying a set of first discharge sustaining pulses to each electrode in a first pair of said display electrodes, both of said sets of first discharge sustaining pulses being different in phase from each other; and

simultaneously applying a set of second discharge sustaining pulses to each electrode in an adjacent pair of said display electrodes, both of said sets of second discharge sustaining pulses being different in phase from each other;

wherein said first set of discharge sustaining pulses applied to one electrode in said first pair of display electrodes and said second set of discharge sustaining pulses applied to an adjacent electrode in said second pair of display electrodes are in the same phase as each other.

24. (New Claim) The method according to claim 21, wherein said X-electrodes and said Y-electrodes are arranged to be substantially parallel to each other, whereby said at least one first discharge sustaining pulse and said at least one second discharge sustaining pulse are applied such that said current in said first pair of display electrodes flows in a substantially parallel, but opposite, direction to said current in said second pair of display electrodes.

25. (New Claim) The method according to claim 23, wherein said X-electrodes and said Y-electrodes are arranged to be substantially parallel to each other, whereby said set of first discharge sustaining pulses and said second set of discharge sustaining pulses are applied such that said current in each of said first pairs of display electrodes flows in a substantially parallel, but opposite, direction to said current in each of said second pairs of display electrodes.

REMARKS

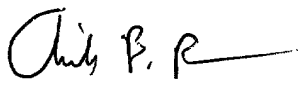
Applicants have amended the specification to place it in better grammatical form. No new matter has been added by these amendments. Applicants have canceled claims 1-20 without prejudice, and added new claims 21-25. Applicants submit that claims 21-25 are in condition for allowance, which is respectfully requested.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached Appendix is captioned "**Version with markings to show changes made.**"

Applicants respectfully request consideration and allowance of the claimed invention. The Examiner is invited to contact the undersigned attorney if an interview would expedite prosecution.

Respectfully submitted,

GREER, BURNS & CRAIN, LTD.

By 

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

In the specification, on page 1, line 1, please insert the following sentence before the paragraph beginning on page 1, line 5.

--This Application is a divisional of Serial No. 08/690,038, filed on July 31, 1996.--

Please amend the paragraph beginning on page 1, line 9, as follows:

-- The plasma display panel (PDP) has good visibility because it generates its own light, is thin and can be made with large-screen and high-speed display. For these reasons it is attracting interest as a replacement for the CRT display. [Especially, a] A surface discharge AC PDP is especially suitable for full color display. [Therefor] Therefore, there are high expectations in the field of high-vision and the demand for a higher quality image is increasing. A higher quality image is achieved by generating higher definition, a higher number of gradations, better brightness, lower brightness for black areas, higher contrast and the like. High definition is achieved by narrowing the pixel pitch, a higher number of gradations is achieved by increasing the number of subfields within a frame, higher brightness is achieved by increasing the number of times a sustaining discharge is performed, and lower brightness for deeper blacks is achieved by reducing the quantity of light emission during the reset period.--

Please amend the paragraph beginning on page 2, line 6, as follows:

-- On the observer-side of one of the glass substrates that face each other, electrodes X1 to X5 are formed in parallel to one another at an equal pitch, and electrodes Y1 to Y5 are formed in parallel to one another to form parallel pairs with the corresponding electrodes X1 to X5. On the other glass substrate, address electrodes A1 to A6 are formed in the direction that runs at a right angle to the aforementioned electrodes, and phosphor covers on that. Between the glass substrates that face each other, partitioning walls 171 to 177 and partitioning walls 191 to 196 are arranged intersecting each other in a lattice, to ensure that no erroneous display is made through discharge of one pixel affecting adjacent pixels.

Please amend the paragraph beginning on page 2, line 19, as follows:

--The surface discharge PDPs have an advantage in that the phosphor [do] does not become degraded due to the impact of ions on it since discharge occurs between adjacent electrodes on the same surface. However, since a pair of electrodes is provided for each of the display lines L1 to L5, the degree to which the pixel pitch can be reduced is limited and this is a stumbling block for achieving high definition. In addition, the scale of the drive circuit must be large since there is a high number of electrodes.—

Please amend the paragraph beginning on page 4, line 21, as follows:

--Moreover, since the color of the phosphor is white or bright gray, incident light from the outside is reflected on the phosphor at non display [line] lines when observing an image on the PDP in a bright place, lowering the contrast of the image.--

Please amend the paragraph beginning on page 5, line 1, as follows:

--In addition, since only one line can be addressed at a time, the address time cannot be reduced, and it is not possible to achieve a higher number of gradations by increasing the number of subfields or to achieve higher brightness by increasing the number of times the sustaining discharge is performed.--

Please amend the paragraph beginning on page 5, line 8, as follows:

--Accordingly, a comprehensive object of the present invention is to provide a plasma display panel, a method of driving same and a plasma display apparatus, all of which [achieves] achieve a higher quality image.--

Please amend the paragraph beginning on page 5, line 12, as follows:

--To put it concretely, a first object of the present invention is to provide[,]
a method of driving a plasma display panel and a plasma display apparatus, which
[achieves] achieve higher definition by further reducing [a] the pixel pitch.--

Please amend the paragraph beginning on page 6, line 3, as follows:

--A fourth object of the present invention is to provide a plasma display panel, a method of driving the same and a plasma display apparatus that can increase [a] the number of gradations and brightness by addressing [a] plural display lines simultaneously to decrease [an] the address period.--

Please amend the paragraph beginning on page 6, line 8, as follows:

--According to the [1st] first aspect of the present invention, there is provided a plasma display apparatus comprising: a plasma display panel having a substrate, electrodes X1 to Xn+1 formed at the substrate, electrodes Y1 to Yn formed at the substrate and address electrodes formed at the substrate or at another substrate facing the substrate at a distance, the electrodes X1 to Xn+1 being arranged in that order and parallel to one another, an electrode Yi being arranged between an electrode Xi and an electrode Xi+1 for each i = 1 to n, the address electrodes being arranged [with] intersecting the electrodes X1 to Xn+1 and Y1 to Yn at a distance; and an electrode drive circuit; wherein the electrode drive circuit includes: first field addressing means, for i = 1 to n, for causing a first address discharge to occur between the electrode Yi and the address electrodes selected in correspondence to display data in a first field of a frame and for causing a discharge to occur between the electrode Yi and the electrode Xi using the first address discharge as a trigger to generate a first wall charge required for a sustaining discharge in correspondence to the display data in the first field; first field

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sustaining means, after the first wall charge [having] has been generated and for odd
number o among 1 to n and for even number e among 1 to n, for supplying a first AC
sustaining pulse between an electrode Yo and an electrode Xo and for supplying a second
AC sustaining pulse between an electrode Ye and an electrode Xe; second field
addressing means, for i = 1 to n, for causing a second address discharge to occur between
the electrode Yi and the address electrodes selected in correspondence to display data in a
second field of the frame and for causing a discharge to occur between the electrode Yi
and the electrode Xi+1 using the second address discharge as a trigger to generate a
second wall charge required for a sustaining discharge in correspondence to the display
data in the second field; and second field sustaining means, after the second wall charge
[having] has been generated and for odd number o among 1 to n and for even number e
among 1 to n, for supplying a third AC sustaining pulse between the electrode Yo and the
electrode Xo+1 and for supplying a fourth AC sustaining pulse between the electrode Ye
and the electrode Xe+1.--

Please amend the paragraph beginning on page 7, line 24, as follows:

--With the [1st] first aspect of the present invention, since the display lines
in odd-numbered [field] fields and the display lines in even-numbered fields can be made
so as not to affect each another in regard to discharge, it is not necessary to provide
partitioning walls along the central lines on the electrodes X1 to Xn+1 and electrodes Y1
to Yn of the plasma display panel. Thus, production of the plasma display panel is

facilitated, reducing the production cost and, with the pixel pitch reduced, higher definition can be achieved.--

Please amend the paragraph beginning on page 8, line 9, as follows:

-- In the [1st] first mode of the [1st] first aspect of the present invention, the first field sustaining means supplies the first and second AC sustaining pulses [with] while ensuring that voltage waveforms applied to the electrodes Yo and Xe are of the same phase to each other, that voltage waveforms applied to the electrodes Ye and Xo are of the same phase to each other and that the first and second AC sustaining pulses are of the reverse phase to each other; and the second field sustaining means supplies the third and fourth AC sustaining pulses [with] while ensuring that voltage waveforms applied to the electrodes Yo and Xo are of the same phase to each other, that voltage waveforms applied to the electrodes Ye and Xe are of the same phase to each other and that the third and fourth AC sustaining pulses are of the reverse phase to each other.--

Please amend the paragraph beginning on page 8, line 24, as follows:

-- The [1st] first mode is effective since the display lines in odd-numbered [field] fields and the display lines in even-numbered [field] fields do not affect each other in regard to discharge.--

Please amend the paragraph beginning on page 9, line 2, as follows:

-- In the [2nd] second mode of the [1st] first aspect of the present invention, the first field addressing means, in a first period, applies a DC voltage to all odd-numbered electrodes among the electrodes X1 to Xn+1 and applies a pulse with a reverse polarity voltage against the DC voltage to the electrode Yo, and in a second period, applies the DC voltage to all even-numbered electrodes among the electrodes X1 to Xn+1 and applies a pulse with a reverse polarity voltage against the DC voltage to the electrode Ye; and the second field addressing means, in a third period, applies the DC voltage to all the even-numbered electrodes among the electrodes X1 to Xn+1 and applies a pulse with a reverse polarity voltage against the DC voltage to the electrode Yo, and in a fourth period, applies the DC voltage to all the odd-numbered electrodes among the electrodes X1 to Xn+1 and applies a pulse with a reverse polarity voltage against the DC voltage to the electrode Ye.--

Please amend the paragraph beginning on page 9 line 19, as follows:

--With the [2nd] second mode, only one pulse with a large width [need] needs to be supplied to each of the odd-numbered group and the even-numbered group of the electrodes X1 to Xn+1 during each address period for the odd-numbered fields and the even-numbered fields. Thus, power consumption is reduced compared to a case in which the pulse must be supplied to those groups for every [scanning] scan of the

electrodes Y1 to Yn. In addition, the structure of the electrode drive circuit can be simplified.--

Please amend the paragraph beginning on page 10, line 3, as follows:

--In the [3rd] third mode of the [1st] first aspect of the present invention, the first field addressing means [apply] applies pulses with reverse polarity voltages to each other to the electrodes Yi and Xi when causing the discharge to occur between the electrode Yi and the electrode Xi; and the second field addressing means applies pulses with reverse polarity voltages to each other to the electrodes Yi and Xi+1 when causing the discharge to occur between the electrode Yi and the electrode Xi+1.--

Please amend the paragraph beginning on page 10, line 12, as follows:

-- With the [3rd] third mode, since only the required pulse is supplied to the electrodes X1 to Xn+1 during an address period, power consumption is reduced compared to a case in which pulses are commonly supplied to the odd-numbered group and the even-numbered group among the electrodes X1 to Xn+1.--

Please amend the paragraph beginning on page 10, line 18, as follows:

--In the [4th] fourth mode of the [1st] first aspect of the present invention, the first and second field addressing means includes: a first sustain circuit for outputting a first voltage-waveform of a DC pulse train; a second sustain circuit for outputting a

second voltage-waveform with its phase offset by 180° from a phase of the first voltage-waveform; a switching circuit having switching elements for selectivity supplying either the first or second voltage-waveform to the electrodes Yo, Ye, Xo and Xe; and a control circuit for controlling the switching elements of the switching circuit in such a way that the first voltage-waveform is supplied to the electrodes Yo and Xe and the second voltage-waveform is supplied to the electrodes Ye and Xo after the first wall charge [having] has been generated and that the first voltage-waveform is supplied to the electrodes Ye and Xe after the second wall charge [having] has been generated.--

Please amend the paragraph beginning on page 11, line 11, as follows:

--With the [4th] fourth mode, since the voltage-waveforms from the first sustain circuit and the second sustain circuit are selectively supplied to the electrodes Yo, Ye, Xo and Xe, the structure of the electrode drive circuit is simplified.--

Please amend the paragraph beginning on page 11, line 15, as follows:

--In the [5th] fifth mode of the [1st] first aspect of the present invention, both the first field and the second field consist of a plurality of subfields with numbers of sustaining discharge pulses different from one another, and the electrode drive circuit further comprising: first field reset means, prior to the first address discharge in a first subfield of the first field and for i=1 to n, for causing a discharge to occur between the electrode Yi and the electrode Xi and between the electrode Yi and the electrode Xi+1 in

Please amend the paragraph beginning on page 12, line 25, as follows:

-- In the [6th] sixth mode of the [1st] first aspect of the present invention, each of the electrodes X1 to X_{n+1} and Y1 to Y_n includes: a transparent electrode formed at the substrate; and a metal electrode formed at the transparent electrode along the central line of the transparent electrode with a width smaller than the transparent electrode.--

Please amend the paragraph beginning on page 13, line 6, as follows:

--With the [6th] sixth mode, the structure of each display line is made identical.--

Please amend the paragraph beginning on page 13, line 8, as follows:

--According to the [2nd] second aspect of the present invention, there is provided a plasma display apparatus comprising: a plasma display panel having a substrate, electrodes X1 to X_{2n} formed at the substrate, electrodes Y1 to Y_n formed at the substrate and address electrodes formed at the substrate or at another substrate facing the substrate at a distance, electrodes X_o, Y_i and X_e being arranged in that order parallel to one another, where $o = 2i - 1$, $e = 2i$ and $i = 1$ to n , the address electrodes being arranged [with] intersecting the electrodes X1 to X_{2n} and Y1 to Y_n at a distance; and an electrode drive circuit; wherein the electrode drive circuit includes: odd-numbered [flame] frame addressing means, for $o = 2i - 1$ and $i = 1$ to n , for causing a first address discharge to occur between the electrode Y_i and the address electrodes selected in

correspondence to display data in an odd-numbered [flame] frame and for causing a discharge to occur between the electrode Y_i and the electrode X_o using the first address discharge as a trigger to generate a first wall charge required for a sustaining discharge in correspondence to the display data in the odd-numbered [flame] frame; odd-numbered [flame] frame sustaining means, for $o = 2i - 1$ and $i = 1$ to n , for supplying a first AC sustaining pulse between the electrode Y_i and the electrode Y_o after the first wall charge [having] has been generated; even-numbered [flame] frame addressing means, for $e=2i$ and $i = 1$ to n , for causing a second address discharge to occur between the electrode Y_i and the address electrodes selected in correspondence to display data in an even-numbered [flame] frame and for causing a discharge to occur between the electrode Y_i and the electrode X_e using the second address discharge as a trigger to generate a second wall charge required for a sustaining discharge in correspondence to the display data in the even-numbered [flame] frame; and even-numbered [flame] frame sustaining means, for $e=2i$ and $i = 1$ to n , for supplying a second AC sustaining pulse between the electrode Y_i and the electrode Y_e after the second wall charge [having] has been generated.--

Please amend the paragraph beginning on page 15, line 11, as follows:

-- Moreover, with [flame] frame interlaced scanning, the address period can be reduced by half compared to that with non-interlaced scanning, lengthening the period of sustaining discharge. This makes it possible to achieve a higher number of gradations

by increasing the number of sub frames or makes it possible to achieve higher brightness by increasing the number of times the sustaining discharge is performed.--

Please amend the paragraph beginning on page 15, line 19, as follows:

--In the [1st] first mode of the [2nd] second aspect of the present invention, the electrodes Xo, Yi and Xe have substantially symmetrical forms relative to a central line of the electrode Yi; each of the electrodes [have] has a transparent electrode formed at the substrate, and a metal electrode formed at the transparent electrode at a width smaller than that of the transparent electrode; and the metal electrodes of the electrodes Xo and Xe are arranged on sides away from the electrode Yi.--

Please amend the paragraph beginning on page 16, line 3, as follows:

--With the [1st] first mode, since, when a voltage is supplied between the electrodes Xo and Yi for instance, the electric field above the electrode Xo becomes more intense on the metal electrode side, the pixel area can be increased essentially compared to a case in which the metal electrode is formed along the central line on the transparent electrode, even if the electrode pitch is reduced to achieve higher definition. This does not present any problem, since the sides of the electrodes Xo and Xe, which are opposite to the electrode Yi, are non display lines, and as the non display lines can be narrowed essentially, this is desirable.--

Please amend the paragraph beginning on page 16, line 15, as follows:

-- In the [2nd] second mode of the [2nd] second aspect of the present invention, the electrodes Xo, Yi and Xe have substantially symmetrical forms relative to a central line of the electrode Yi; the electrode Yi is a metal electrode formed at the substrate; each [of the] electrode Xo and [the] electrode Xe has a transparent electrode formed at the substrate, and a metal electrode formed at the transparent electrode at a width smaller than that of the transparent electrode; and the metal electrodes of the electrodes Xo and Xe are arranged on sides away from the electrode Yi.--

Please amend the paragraph beginning on page 16, line 25, as follows:

--With the [2nd] second mode, since the width of the electrode Yi [become] becomes small, the power consumption of supplying scanning pulses to the electrode Yi is reduced. In addition, it is possible to further reduce the pixel pitch. --

Please amend the paragraph beginning on page 17, line 4, as follows:

--In the [3rd] third aspect of the present invention, there is provided a plasma display panel comprising [a] substrate sustaining electrodes, for sustaining discharge, formed in parallel to one another at the substrate and address electrodes formed at the substrate or at another substrate facing the substrate at a distance, the address electrodes being arranged [with] intersecting the sustaining electrodes at a distance in parallel to one another, the plasma display panel further comprising a light

blocking member at a non display line between adjacent electrodes of the sustaining electrodes.--

Please amend the paragraph beginning on page 17, line 15, as follows:

--With the [3rd] third aspect, by employing the light blocking member, reduction of the black display quality caused by discharge light emission at the non display line can be decreased.--

Please amend the paragraph beginning on page 17, line 19, as follows:

--In the [1st] first mode of the [2nd] second aspect of the present invention, the address electrodes are covered with phosphor, and an observer-side surface of the light blocking member has darker [colour] color than the phosphor.--

Please amend the paragraph beginning on page 17, line 23, as follows:

--With the [1st] first mode, since incident light from the outside to the phosphor at the non display line is absorbed by the light blocking member, the contrast of an image on the PDP in a bright place increases more than a case that incident light from the outside to the phosphor at the non display line is reflected and enters eyes of an observer.--

Please amend the paragraph beginning on page 18, line 4, as follows:

--In the [4th] fourth aspect of the present invention, there is provided a plasma display apparatus comprising: a plasma display panel having a substrate, electrodes X1 to Xn formed at the substrate, electrodes Y1 to Yn formed at the substrate, address electrodes formed at the substrate or at another substrate facing the substrate at a distance and a light blocking member between electrodes Yi and Xi+1, where i=1 to n-1, electrodes Xi and Yi being arranged by [terns] turns in parallel, where i=1 to n; and an electrode drive circuit; wherein the electrode drive circuit includes: reset means, for i=1 to n-1, for causing a discharge to occur between the electrode Yi and an electrode Xi+1 [with] while ensuring that voltage waveforms applied to the electrodes Xi and Yi are in the same phase to each other and that voltage waveforms applied to the electrode Xn and the electrode Yn are in the same phase to each other in a reset period; addressing means, for i=1 to n, for causing an address discharge to occur between either the electrode Xi or Yi and the address electrode selected in correspondence to display data and causes a discharge to occur between the electrode Xi and electrode Yi using the address discharge as a trigger to generate a wall charge required for a sustaining discharge in correspondence to the display data in an address period after the reset period has elapsed; and sustaining means, for i=1 to n, for supplying an AC sustaining pulse between the electrode Xi and the electrode Yi in a sustain period after the address period has elapsed.-

Please amend the paragraph beginning on page 19, line 6, as follows:

--With the [4th] fourth aspect, by employing the light blocking member, reduction of the black display quality caused by light emission during a reset period can be decreased. Although the light blocking member will somewhat prevent achieving higher definition, in comparison to the structure in the prior art shown in FIG. 30, since it is not necessary to form the partitioning walls 191 to 196, production is facilitated and the pixel pitch can be further reduced.--

Please amend the paragraph beginning on page 19, line 14, as follows:

-- In the [5th] fifth aspect of the present invention, there is provided a plasma display panel comprising a substrate, address electrode bundles formed along to one another at the substrate and scanning electrodes, for causing a discharge between the address electrode bundles and the scanning electrodes to generate a wall charge required for a sustaining discharge in correspondence to display data, the scanning electrodes intersecting the address electrode bundles at a distance, wherein each of the address electrode bundles includes: m ($m \geq 2$) number of address electrodes formed along to one another at the substrate in correspondence to one monochromatic pixel column; pads arranged along a lengthwise direction of the address electrodes corresponding to each monochromatic pixel, the pads being above the m number of address electrodes relative to the substrate; and contacts for connecting one pad to one of the address electrodes in a regular manner along the lengthwise direction of the address electrodes.--

Please amend the paragraph beginning on page 20, line 8, as follows:

--In the [5th] fifth aspect, by selecting m number of the scanning electrodes intersecting the pads connected to the m number of address electrodes simultaneously; and by applying voltages corresponding to display data to the m number of address electrodes simultaneously; scanning of the scanning electrodes is executed in units of m lines.--

Please amend the paragraph beginning on page 20, line 14, as follows:

-- With the [5th] fifth aspect, a plurality of lines can be addressed at the same time, reducing the address period and, because of this, a higher number of gradations becomes possible by increasing the number of subfields or it becomes possible to achieve higher brightness by increasing the number of times sustaining discharge is performed.--